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CONTRIBUTIONS

TO

AMERICAN HELMINTHOLOGY.

No. 1.

BY

R. RAMSAY WRIGHT.

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BY R. RAMSAY WRIGHT, M.A., B.Sc.,

Professor in University College, Toronto.

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The observations recorded in the following pages were made for the most part during the months of September and October of the present year. Teaching duties have, however, prevented the completion of many of them; and it is only in consideration of the difficulty of procuring, during the winter, fresh material with which these might be supplemented, and of the fact that certain other interesting forms (which I hope shortly to describe to the Institute) have recently engaged my attention, that I publish these notes in their present fragmentary condition.

The work was undertaken with the desire of contributing towards a wider knowledge of the anatomy of Trematodes. In the attempt, however, to diagnose the forms that presented themselves for examination, it became apparent that in spite of the extensive contributions of Dr. Joseph Leidy, much work of a faunistic character remains to be done in this department on this continent.

The present paper has assumed in this way more of a systematic character than was originally intended; although there are, it is hoped, some points of interest to the general zoologist.

Certain important memoirs are not accessible to me here; owing to which there are, no doubt, misstatements or omissions which might otherwise have been rectified.

TREMATODES.

1ST SUB-ORDER—DIGENEA. VAN BEN.

1.—DISTOMUM HETEROSTOMUM. *Rud.*

I refer provisionally to this species certain worms which I have found on two occasions firmly adhering to the mucous membrane

of the mouth of the American Bittern (*Botaurus minor*, Gm.) at the sides of and below the tongue.

The following species, according to V. Linstow's excellent "Compendium," have been found in the cavity of the mouth or in the oesophagus of Ciconiæ:

- | | | | | |
|---------------------------|-------|------------|-------|------------------------|
| 1. <i>D. complantum</i> | | oesoph | | <i>Ardea cinerea</i> . |
| 2. <i>D. heterostomum</i> | | sub lingua | | <i>A. purpurea</i> . |
| 3. <i>D. hians</i> | | oesoph | | <i>Cic. alba</i> . |
| 4. <i>D. dimorphum</i> | | " | | <i>A. cocoi</i> . |

These forms are closely related; indeed, Dujardin¹ regards the first two as identical with the third, and Diesing² seems to suggest that the first and fourth are also related. The separation by Diesing of *D. hians* from these congeners, on account of the relative size of the suckers, may possibly be grounded on a mistake. The anterior end of the worm which I possess resembles closely that of *D. dimorphum* (see Diesing's figure),³ and it is more than probable that the prominent border which surrounds the mouth in these forms has been taken for the anterior sucker. This it seems to replace functionally in part in my specimens; for during life it undergoes rapid changes in shape, sometimes having a circular sometimes a triangular aperture, and plays an active part in the locomotion of the animal; while the anterior sucker is quite distinct, although small, and is immersed in the papilla which springs from the anterior depression. (See Fig. 1).

The following points in the description of *D. heterostomum* induce me to refer my specimens to it until a comparison can be made: the habitat, size, *two lateral lines*, form of anterior end of body, of neck and of ventral sucker, position of genital organs and apertures.

The details which follow are for the most part taken from dead specimens.

The form of the body is subject to much variation. Fig. 1 represents it at rest. Length, 6.85 mm.; greatest breadth, 1.5 mm. It may, however, lengthen into a much more linear form. The anterior sucker is 0.3 mm. in diameter, its aperture transversely elliptical. The pharynx has thin walls, is still smaller, and gives off the intestinal coeca immediately, which are very conspicuous from the deep brown pigment in their walls. They have the further peculiarity of

¹ Helminthes, p. 390.

² System. Helm. I. 354.

³ Neunzehn Arten Tremat. X. B. Denkschr. d. k. Akad. in Wien., Taf. III., 2 & 3.

being provided on each side, at any rate in the trunk, with short, sometimes branched, diverticula (Fig. 2), which, however, project much less in the most extended condition of the animal. This character seems to be shared by *D. dimorphum*,⁴ and although present in many Polystomeæ (*Epibdella*, *Diplozoon*, *Onchocotyle*, &c.), is by no means common in Distomeæ.⁵

The ventral sucker is situated 0.8 mm. behind the anterior, and is 0.8 mm. in diameter. Its cavity is deep and gaping during life; frequently its orifice is circular from strong contraction of the radial fibres, usually *shield-shaped* or triangular.

The excretory system has a large caudal pore, and two much convoluted lateral stems, which run along the sides to the neck. During life I observed that the granules contained in these also circulated through the vacuolated parenchyma of the body, although they did not seem to enter the plexus of fine canals which could be seen immediately under the outermost investment. The parenchyma reminded me of that which I have myself observed, and which has been described by Fol and others, in the foot of embryonic Gastro-pods. This connection between water-vascular system and parenchyma spaces has been insisted on by Sedgwick Minot.⁶

I have not been able to follow satisfactorily all of the genital organs. The vitellogens (see Fig. 1) are in the form of racemose glands grouped round the intestinal coeca, and occupying the interval between these at the hinder end of the body. The testes (*t*) are two in number, and between them are the ovary, first convolutions of the oviduct, and a retort-shaped receptaculum seminis, from which I am inclined to believe a canal (vagina?) passes upwards towards the back, although I have failed to detect this in my preserved specimens. Towards the right side of the anterior testis is a structure whose function I have not been able to determine. It is possibly the thickened end of the oviduct at its junction with the uterus; at any rate the thickened tube projects into the bottom of the thin walled uterus, and is subject to a regular and slow evagination of the anterior part of its inner surface, recalling the gradual eversion of the peristome in a Vorticella. This is followed by a rapid retrac-

⁴ Diesing's fig., loc. cit.

⁵ Schmarda, Zoologie, attributes this character to *D. cynoides* and *clavigerum* of the Frog; Pagenstecher's figures (*Trematodenlarven und Trematoden*) do not corroborate this.

⁶ On *Distomum crassicolle*. Mem. Bost. Soc. N. H., Vol. III., p. 8.

tion. It may be similar to the "Schluck-öffnung" observed by Vogt in certain marine Trematodes.⁷

The genital orifice, as in *D. dimorphum*, is situated behind the ventral sucker about 1 mm. No cirrus was detected. The oval eggs have a thickish yellow shell, with a lid at the narrow end, and measure 0.099 mm. by 0.066 mm.

2.—*DISTOMUM ASPERUM*, n. sp.

One of the two examples of *Botaurus minor* above referred to yielded ten specimens of a Distome occupying two varicose dilations of the bile-duct, recalling the swollen bile-ducts described by Cobbold⁸ in a Porpoise. The worms proved to belong to Dujardin's sub-genus *Echinostoma*; and I at first believed that they might be *D. ferox*, Zeder, first detected by Goeze in dilated intestinal follicles of *Ardea stellaris*. I was more inclined to do so from discrepancies in the various descriptions of this form.⁹ Certain peculiarities, however, seem to me to mark it off from that species, of which it is undoubtedly a near relative, and I accordingly propose the specific name "*asperum*" for my specimens.

DESCRIPTION (Figs. 3, 4, 5).—Body yellowish white, 8.19 mm. long, 1.8 mm. broad in middle, tapering gradually to each end; the head and anterior part of neck narrower than tail; covered entirely with persistent spines 0.054 mm. long, somewhat sparse posteriorly; head reniform, with a coronet of 27 obtusely-pointed spines, four of which on each side of a median ventral notch are larger (0.155–0.16 mm.) than the others (0.117 mm.), and radiate from nearly a common point of origin; anterior sucker terminal, with projecting circular lip 0.14 mm. in diam.; ventral large (0.75 mm.), situated at junction of anterior and middle thirds of body. Vitelligenous glands chiefly in neck, but accompanying intestinal coeca to posterior end.

The orbicular neck of *D. ferox*, its deciduous spines only present anteriorly, the position of its ventral sucker, and the constriction of the body there, together with the arrangement of the coronal spines, seem to distinguish it effectually from *D. asperum*.¹⁰ The genital

⁷ Zeit. f. Wiss. Zool., B. XXX., Suppl., p. 307, f.

⁸ Jour. Linn. Soc. XIII., p. 39.

⁹ For lit. see Dies. Syst. I., p. 387; Molin. Denkschr. d. k. Akad. in Wien XIX., p. 219; Olsson, Kongl. Svensk. Vetensk. Akad. Handlingar. XIV., p. 22. I have not access to Van Beneden's paper, "Sur la cigogne blanche et ses parasites." Bull. Acad. Belg. XXV.

¹⁰ Cf. Fig. 4 with Olsson's Fig. 50 loc. cit.; also V. Linstow's descr. Trosch. Archiv., 1873, . 106, and Dujardin's.

organs answer well to Olsson's description of *D. ferox*; the eggs, however, measure 0.096 mm. $\times$ 0.069 mm., while the following are measurements given for *D. ferox*:

0.092 - 0.102 mm. $\times$.049 mm. (Dujardin).

0.06 mm. $\times$ 0.04 mm. (Olsson).

The penis, exerted in all my specimens, is smooth, and measures about 2 mm. in length.

The pharynx is pistilliform; the intestine bifurcates 2.08 mm. from the anterior end, and is very easily distinguishable from its dark brown contents (probably broken down epithelium and blood corpuscles),

3.—*DISTOMUM RETICULATUM*, n. sp.

The Assistant Curator of the University Museum, while preparing a specimen of the Belted Kingfisher (*Ceryle alcyon*, Boie) in April, found two Trematode worms "on the surface of the lung," which present in many respects a remarkable resemblance to *D. hepaticum*, L. I believe them to be hitherto undescribed, and I propose for them the specific name "*reticulatum*," referring to the beautiful network formed by the branching and anastomosing testicular tubes shining through the translucent testicular area.

DESCRIPTION (Fig. 6).—Body *ovate*, flat, *slightly concave ventrally*, separated by a constriction and *large and projecting acetabulum* from the *upturned neck*. Total length, 14 mm.; greatest breadth, 8 mm. Entirely covered with recurved *rounded 0.025 mm. long spines*, which are closer and smaller on anterior part of neck. Anterior sucker bowl-shaped, 0.9 mm. wide. Acetabulum 1.3 mm. diameter, orifice circular. Pharynx oval, thick-walled, 0.48 mm. wide. Intestinal coeca *unbranched* (?). Bifurcation shortly behind pharynx. Genital orifice immediately in front of acetabulum. Penis (?). Uterine gyri overlying and extending behind the acetabulum. Testes, in the form of branched tubes, occupying a translucent *oval area*, with black borders *narrower posteriorly*, formed by the vitelligenous glands, which are disposed in a racemose manner round a dorsal and a ventral longitudinal stem on each side. Eggs average 0.11 mm. $\times$ 0.065 mm.

The above description contains most of the points which can be observed by studying this worm entire by the aid of a compressorium. Probably slicing will give better results as to the disposition of the genital apparatus and intestinal coeca. The ease with which the

intestine can be made out in *D. hepaticum* depends entirely on the dark contents: the bifurcation was here observed from the dorsal surface, but the branches were empty. The longitudinal muscular fibres are strongly developed on the ventral surface, and the ventral surface of the neck has two sets of oblique decussating fibres, as in *D. hepaticum*.¹¹ The transverse vitello-duct can be easily seen with the naked eye. The right half is longer than the left, and the common duct, leading obliquely upwards (towards an Ootype?), is narrower than either.

4.—*DISTOMUM VARIEGATUM*. Rud.

In looking for *Polystomum*-eggs from a specimen of *Rana halecina*, Kalm, in the way recommended by Zeller,¹² I found that a worm had been voided by the frog, which turned out to be *D. variegatum*, Rud. It had been partly macerated from exposure to the water; the acetabulum was consequently even more than ordinarily difficult to make out, and the characteristic coloration was destroyed. The application of picrocarminate, however, is particularly successful in rendering distinct the different organs in Trematodes, and probably more so in such a case as this from the previous bleaching.¹³

The intestinal coeca were entirely destitute of contents, and their epithelial lining (average individual cells of which [Fig. 7] measured superficially 0.03 mm. $\times$ 0.021 mm.) was well seen.

The left lung of the same animal yielded only one well-coloured example of the worm.

My examples agree well with Pagenstecher's description and measurements,¹⁴ except that the ventral sucker was easily discoverable in the fresh worm, and that the testes, three in number, which seemed to be composed of flask-shaped cells empty of their contents, and with the neck of the flasks converging to the vas deferens, could hardly be called small. The vitelligenous glands, as Blanchard has already figured,¹⁵ are in the form of six or seven scattered racemose clumps on each side, with a connecting longitudinal stem.

¹¹ Leuck. Mensch. Par., I., 537.

¹² Zeit. für. wiss. Zool. XXVII., p. 255, f. n.

¹³ After writing the above, I notice that the use of picrocarminate has been already recommended by Dr. G. Duchamp (Journal de Micrographie, July, 1878).

¹⁴ Trematodenlarven und Trematoden, p. 41.

¹⁵ Ann. des Sci. Nat. 3 S. VIII., Pl. 13, f. 1.

5.—*DISTOMUM GRACILE*. *Diesing*.*CLINOSTOMUM GRACILE*. *Leidy*.

This worm was first described by Dr. Leidy,¹⁶ who regarded it as generically different from *Distomum*. He records it from the intestines of a Pike, and from cysts in the gills, fins and muscles of *Pomotis vulgaris* (auritus), Günther. I have found the same worm in cysts on the branchiostegal membrane and anterior fins of *Perca flavescens*, Cuv. This species appears to me to belong to the same group as *D. heterostomum* and *D. dimorphum*, from the structure of the anterior end, and of the ventral sucker. In a specimen of 6.45 mm. in length, with a greatest breadth of 1.8 mm. across, the mouth sucker measures 0.338 mm. across, and the prominent border which surrounds it 0.975 mm. The large ventral sucker (0.91 mm.) is situated in the middle of a constriction dividing the neck from the body, and has a triangular aperture. Its cavity is lessened by three triangular tongues, which project into it so as nearly to meet each other. The anterior of these points with its apex backwards; all are formed chiefly of radial fibres, and they must undoubtedly increase the efficiency of the sucking apparatus very considerably.

The species of *Distomum* which have been found included in cysts are either fully mature (*D. agamos*, V. Linst.,¹⁷ *D. Okenii*, Köll., *D. crassicolle*, R. [Pontallié]), or have only one part of the sexual apparatus ripe (*D. hystrix*, Dujard., the testes¹⁸), or are finally quite immature. In the last category fall *D. annuligerum*, Nordm., *D. diffusocalciferum*, Gastaldi, *D. dimorphum*, Diesing, and, as I believe, *D. gracile*. No mention of generative organs is made in Leidy's description, and I have failed to detect any trace of such. The Sunfish and Perch can consequently hardly be regarded as the definitive hosts of this worm. Probably the sexually mature worm is to be sought for in the intestine of some larger fish (Pike?) or piscivorous bird. In the latter case, the relationship between the immature and mature form would resemble the two forms of *D. dimorphum* described by Diesing.

The intestinal coeca are large, and extend nearly to the posterior end; the contents are yellowish-brown, and include some lozenge-shaped concretions.

¹⁶ Proc. Ac. Sci. Phil. VIII., p. 46.

¹⁷ Trosch. Arch. XXXVIII., B. L., p. 1, f.

¹⁸ Olsson, Lund's Univers. Årskr. IV., p. 62.

The water-vascular system has a wide median stem, which continues from the caudal pore half way to the ventral sucker, giving off in its course lateral branches, which communicate with the finer canals of the system. One of my specimens, which had been preserved in alcohol, was placed in a diluted carmine solution resembling Beale's, but the fluid, instead of staining the tissues to any extent, entered the water-vascular stem and injected the subcuticular mesh-work, resulting in a beautiful preparation resembling the actual injections from which Blanchard's figures of the water-vascular system in various Trematodes are taken.¹⁹ Rounded calcareous corpuscles occurred in great numbers in the median stem and its primary branches; these seem to be especially abundant in immature Trematodes.

On the ventral surface behind the acetabulum were several series of dark granular spots—perhaps the optical expression of cutaneous glands.

2ND SUB-ORDER—MONOGENEA. VAN BEN.

1.—OCTOBOTHRUM SAGITTATUM. *F. S. Leuck.*

PLACOPLECTANUM SAGITTATUM. *Diesing.*

I possess several specimens of a worm from the gills of one of our fresh water fishes here, probably *Catostomus teres*, Le S., which were, unfortunately, preserved without any label, and as to the habitat of which I am consequently uncertain.

A comparison of Fig. 19, Pl. II., with Leuckart's figure of *Octobothrium sagittatum*,²⁰ will show the great similarity between the appearance of the worms. I cannot reconcile certain points in his description with what I have ascertained from these specimens; but I propose to refer to these provisionally under this heading until I have access to a more satisfactory description of the worm living on the gills of the European brook trout, and until I secure fresh specimens of the form taken here.

The body is arrow-shaped, 6 mm. in length, with a greatest breadth of 1.5 mm. The body is separated by a marked constriction from the caudal disc, which is notched posteriorly, and has four suckers on each side of its ventral face.

The structure of these suckers is at variance with Leuckart's description. It is with great difficulty that one can succeed in getting a satisfactory view of the chitinous framework, under a cover glass,

¹⁹ Loc. cit., Pls. IX. and X.

²⁰ Zoolog. Bruchstücke, III., Taf. V.

without distorting some part of it. The only way to obtain a correct view of the structure of the suckers, is to examine them in the first place with incident light before they have been subjected to pressure. I believe that Fig. 8 conveys a correct interpretation of the disposition of the parts of the framework.

The suckers have short muscular pedicels and an oval aperture, the long axis of which is directed transversely to the caudal disc, and which has a nearly continuous chitinous ring. This ring is interrupted by hinges at four points in its course, viz., the middle points of the outer and inner borders, from each of which a hook arches over the aperture of the sucker, and the middle points of the anterior and posterior borders, where it meets with a mesial piece which traverses the concave floor of the sucker. I have never been able to establish the continuity of this with the anterior border of the ring, and am inclined to believe that they do not meet.

The aperture of the sucker may be narrowed so as only to leave a chink between its approximated anterior and posterior borders. This is effected by the outer and inner hinges, and the appearance of the framework is changed by the greater curvature thus given to the mesial piece, and by the free hooks being pressed backwards toward the posterior border. I believe that Leuckart's figure is drawn from the framework in this position; in which case it is possible to identify the pieces shown in both figures.

The aperture of the sucker may also be narrowed in a direction at right angles to the above, in which case the hinges from which the free hooks project become more apparent. This seems to agree better with Olsson's figures (*loc. cit.*) of the suckers in various species of *Octobothrium*.

The mouth-suckers are somewhat peculiarly formed, the muscular tissue being interrupted at the inner margin of each (Fig. 20, Pl. II.).

The intestinal coeca are invested throughout by a thick layer of viteligenous glands, forming two dark-coloured stripes in the body, on each side of and between which a somewhat more translucent area is to be seen.

The abundance and opacity of these glands render the examination of the genital organs difficult; the following points were, however, made out.

The only genital orifice detected is situated 0.78 mm. from the anterior end. It is a circular sucker of 0.135 mm. diameter, which,

when viewed superficially, shows radial fibres and an irregular quadrangular orifice; but when the glass is pushed deeper, shows a doubly contoured ring 0.0135 mm. diameter, surrounded by circular fibres. (Fig. 21.) The ovary is somewhat bilobed, the ovarian eggs are polygonal from mutual pressure, and measure 0.009 mm. The fully formed egg differs much from Leuckart's figure, and approaches those described by Olsson for various species of *Octobothrium*. Its oval body measures 0.195 mm. in length, while the whole egg is 1.04 mm. long. (Fig. 22.)

The testis lies behind the ovary, and its vas deferens, surrounded by strong circular fibres, is continued forwards near the dorsal surface of the body. It probably opens by the same aperture as the oviduct; at any rate, I have not been able to detect any trace of a second genital aperture.

2.—*POLYSTOMUM OBLONGUM*, n. sp.

In September I had the opportunity of dissecting a single specimen of the Musk Turtle (*Aromochelys* [*Sternotherus*] *odoratus*, Gray): the only parasites obtained from it were four examples of an undescribed species of *Polystomum* found in the urinary bladder. No Helminths, as far as I am aware, have been hitherto obtained from this organ in *Chelonia*; the fact, however, that *P. ocellatum* is described from the cavity of the mouth in two Old World Turtles, suggested to me that I had perhaps in these a bladder stage of that worm, and that the two known species of *Polystomum* had in this way a precisely parallel history.²¹ A closer examination and comparison with the characters of the two described species, showed that the worms presented peculiarities of specific value. I hope shortly to have the opportunity of examining the other turtles (*Chrysemys picta*, *Chelydra serpentina*) which are common in this neighbourhood, and have no doubt that *Polystomes* will be found in the oral cavity as well. An examination of the urinary bladder of *Emys Europaea* might not be without results in this respect.

DESCRIPTION (Figs. 9, 10, 11).—Body oblong, mouth on the ventral surface of the rounded anterior end. Pharynx bowl-shaped. Intestinal coeca without anastomoses or branches. Generative outlets in front of the line of the lateral vaginæ. Cirrus-coronet of sixteen alternately small and large sabre-shaped pieces. Viviparous. Length up to 2.5 mm., breadth to 1.5 mm. Egg, greenish, 0.235 mm. $\times$ 0.195 mm. Larva ocellate 0.5 mm. in length.

²¹ For life-history of *P. integerrimum*, v. Zeller. Zeit. wiss. Zool. XXVII., p. 238 f.

The general outline of the body is somewhat oblong when the worm is at rest; in motion, however, its form is capable of considerable variation, and it is especially then that the constriction corresponding to the position of Zeller's "Seitenwülste" is noticeable. The caudal lamina is somewhat narrower than the greatest width of the body, and is shorter than it is broad. The body narrows considerably at its junction with the caudal lamina.

The hooks and suckers are disposed very much as in *P. integerrium*. The suckers (0.2 mm. in diameter) seem to project rather more than in that species, and their prominent rim bears a series of rounded apertures similar to those spoken of above in describing the suckers of *Octobothrium sagittatum*. The smaller hooks (Fig. 11) measure 0.015 mm. in length. The six anterior of these are situated in pairs between the two anterior suckers. They have a knobbed attached end, with an arm (longer than represented in the figure) projecting at right angles not far from the middle of the hook. The four posterior (situated between the larger hooks) are capable of more independent action than the others. This was evident when the worm endeavoured to free itself from the piece of thin glass by which it was covered. The two large hooks measure 0.15 mm., and have a proportionately deeper notch than those of *P. integerrium*.²²

No eye-spots were observed in the adult worm. The longitudinal system of muscular fibres seemed to be most developed.

The mouth is transversely oval, and is surrounded by a well-marked sucker, in which radial and vertical fibres preponderate. It leads immediately into a bowl-shaped pharynx, the walls of which possess merely weak circular fibres, and from this the simple intestinal coeca arch backwards directly. The coeca of all the observed specimens were empty.

Only the convoluted lateral stems of the water-vascular system were observed near the anterior end.

The lobes of the vitellogen are more scattered than in *P. integerrium*, and do not extend into the caudal lamina. The transverse duct seemed to pass inwards dorsally from the intestinal coeca; but I have been unable to determine the relationship of the internal generative organs, partly from the fact that my specimens were taken from the turtle the day after it was killed, and consequently had very little vitality.

²² Cf. Zeller, loc. cit., Taf. XVII, p. 12.

The testis is a solid gland situated in the posterior third of the body. The course of the vas deferens is shown in the figure. No internal vas deferens was observed. The male outlet lies immediately behind the bifurcation of the intestine, and is armed with sixteen alternately large and small hooks, which differ considerably in form from those of *P. integerrimum*. The free end of each piece is sharply curved; the attached end is shaped like a cross, the transverse piece of which is longer on one side than the other. The longer pieces measure 0.02 mm., and the shorter ones 0.015 mm. Whether there is any connection between the attached ends, I am unable to say.

The comparative transparency of the body would render the examination of the internal organs of this species of *Polystomum* particularly easy. I failed, however, to satisfy myself as to their disposition, from the cause noted above.

As in *P. integerrimum*, there are two lateral cushions, in this case each situated in a depression, which communicate with canals (vaginae) leading towards the middle of the body. The inner ends of these I could not follow. A third canal, originating from an oval body with brown contents (shell-gland?), situated on the left side of the middle line (ov, Fig. 9), likewise was observed to take the same direction. The ovary (not represented in the figure) is situated in front of the testis on the right side of the body. The short oviduct terminates in a wide uterus, in which only a single egg can be accommodated at one time. The egg-shell is somewhat thin, is destitute of the short stump present in that of *P. integerrimum*, but has a rather large operculum.

In each of the two most active specimens of the worm which I secured, a *Gyrodactylus*-like larva, similar to that of *P. integerrimum*, and with eye-spots disposed in the same fashion, had already escaped from the shell, and was moving actively within the uterine chamber.²³ The motions seemed to depend entirely on the muscles and the hooks of the caudal disc. This had a rounded outline, except posteriorly, where there was a square projection bearing the four posterior small hooks. The disc measured 0.114 mm. across, and the twelve anterior

²³ According to Zeller (loc. cit., p. 269, note), "die Eier bei den jüngsten fortpflanzungsfähigen Harnblasenpolystomen durchmachen ihre Entwicklung noch innerhalb des Eierleiters." I am not sure whether to conclude from this that, as in the present instance, larva and egg-shell are extruded separately from the uterus. I am inclined to believe, however, taking into consideration the size and advanced state of development of the larva, the absence of cilia, and the thinness of the egg-shell, that this viviparous method is the normal in *P. oblongum*.

small hooks were disposed at regular intervals on the margin of the rounded part of the disc. There was no trace of suckers. The small hooks had already attained their definitive size and form; the two large ones, on the other hand, situated considerably further in from the margin than in the adult, measured only 0.024 mm. instead of 0.15 mm. This difference in length is owing to the shortness of the immersed portion, in which, however, the notch is already formed.

It will be seen that in respect of the state of development of the large caudal hooks, this larva differs considerably from that of *P. integerrimum*. It is also larger, measuring 0.5 mm. in length, instead of 0.3 mm.

SPHYRANURA OSLERI, nov. gen. et spec.

I have lately received from my friend Professor Osler, of Montreal, several specimens of a worm taken from the gills and cavity of the mouth of our common Lake-Lizard (*Necturus* [Menobranchus] lateralis, Raf.) These had been preserved for eight years in Goadby's fluid, and proved comparatively useless for further examination, having become quite opaque and black in colour. From some specimens, in a good state of preservation, mounted by Dr. Osler for microscopical examination, and also from his notes and sketches made on observation of the fresh specimens, I am able to communicate the following. The only specimen of *Necturus* which I have had the opportunity of examining since receiving these did not yield any of the worms.

According to Diesing's conspectus (*Revision der Myzhelminthen*), the worms ought to fall into his genus *Diplectanum*. I have not access to Wagener's later descriptions of the two species of this genus. It is evident, however, from a study of Van Beneden's²⁴ and Vogt's²⁵ figures and descriptions of *D. æquans*, that this form cannot be referred to *Diplectanum*. It resembles *Polystomum*, and differs from *Dactylogyrus* and *Diplectanum* in the following points: (1) The size and shape of the egg; (2) the structure of the suckers; (3) the disposition and number of the caudal hooks. It differs from *Polystomum* in the general form, the number of suckers, and the structure of the

²⁴ Rech. sur les Tremat. marins, p. 122, Pl. XIII.

²⁵ Zeit. für wiss. Zool., Suppl. XXX., Taf. XIV. 2, XVI. I.

genital apparatus, and I propose for its reception the generic name "Sphyranura," with the following characters:

Body depressed, somewhat elongate, expanded posteriorly into a caudal lamina, *considerably wider* than the body, bearing two immersed acetabula, two large hooks behind these, and sixteen small hooks (seven along each side of the lamina, and one in the centre of each acetabulum). Mouth ventral anterior, somewhat funnel-shaped, intestine with two branches anastomosing posteriorly. Excretory pore between the acetabula, *two contractile bladders anteriorly*. Oviparous. Parasitic on the gills and in the mouth of perennibranchiate Amphibia.

The specific characters in the allied genera are derived chiefly from the size, the caudal and genital armature, and the size and shape of the eggs. I accordingly note the following as characteristic of this species, which I propose to associate with the name of Dr. Osler as *S. Osleri, n. sp.* (Figs. 12, 13, 14.)

Body 2.6 mm. in length by 0.7 mm. in breadth, narrowed at each end, especially where it joins the caudal lamina, which measures 1 mm. across, and about 0.45 mm. in length. Large hooks 0.2 mm. long. Oviduct occupying the interval between the intestinal coeca, with numerous eggs; uterus with single mature egg, oval, with brownish-yellow shell, 0.364 mm. $\times$ 0.247 mm.

I am not aware that any monogeneous Trematode, with the exception of *Polystomum integerrimum*, has been hitherto found in any amphibian; and this seems to be restricted to the tailless forms. A careful examination of the gills, mouth-cavity, and urinary bladder of both perennibranchiate and caducibranchiate Urodelæ would probably yield interesting results with regard to this family of Trematodes.

I regard the form under consideration as of great interest in view of the frequently asserted²⁶ relationship between *Dactylogyrus* and *Gyrodactylus* on the one hand, and *Polystomum* on the other, and I propose to recur to this after detailing the facts which I have been able to elucidate with the material at my disposal.

²⁶ Von Siebold, Untersuchungen über *Gyrodactylus*. Van Benoden, Animal Parasites, Eng. Ed., p. 261. Willemoes-Suhm, Zeit. f. wiss. Zool. XXI. I have not seen this paper. The following is from Hofmann und Schwalbe's Jahresberichte für 1872, p. 274: "Hat Zeller den Lebenslauf der Thiere vorzüglich aufgeklärt so gebührt Willemoes-Suhm die Priorität der Publicirung der Beschreibung der Larve, sowie die Andeutung, dass die Aehnlichkeit derselben mit einem *Gyrodactylus* eine phylogenetische Entwicklung von *Polystomum* und *Gyrodactylus* aus einer Stammform wahrscheinlich mache."

The measurements on Fig. 12 are taken from a specimen in which the eggs are nearly ripe. The worm somewhat resembles a hammer in shape, the body forming the shaft of the hammer and the tail-piece the head. This resemblance is greater in the hardly-mature specimens, where the oviduct is not dilated with eggs, and the body consequently more linear in outline.

The caudal lamina is considerably wider than the body. It is longest at each side, and somewhat shorter in the middle through the presence of a posterior notch, which may become considerably deeper, dividing the disc into two very well marked halves when the large caudal hooks are in vigorous action, owing to the course of the muscular bands which are attached especially to the innermost forks of these. The suckers resemble in all respects those of *Polystomum*; the prominent rims do not present the rounded apertures which I have noticed above in *P. oblongum*. The diameter of the suckers is 0.27 mm. The large hooks (Fig. 13) differ in form from those of *Polystomum* or of any species of *Dactylogyrus*; and, in fact, except for the impair trabecula present in the latter genus, the hooks of some forms of *Dactylogyrus* and of *Polystomum* resemble each other more closely than they do those under consideration. The attached end of the hook is divided into two pieces: one—the longer—a thin, flat, somewhat linear splint in the continuation of the axis of the rounded body of the hook; the other, thicker, shorter and rounder, standing at an angle of 45° from that axis, with two prominences for muscular attachment. I observe that the splint-like portion is bent in some specimens; this is perhaps due to pressure in mounting. The free portion of the hook, just in front of the bend, bears two little curved teeth, one rising from the surface of the other, which probably assist in securing the attachment of the animal. Similar teeth seem to be present on the hooks of *Dactylogyrus monenteron*, Wagener.²⁷

I have not been able to elucidate very successfully the structure of the smaller hooks. I have only attempted to indicate their position in Fig. 12. Even their number remains somewhat doubtful; only in one small specimen have I succeeded in making out sixteen. They are much less easy to observe in the larger worms; perhaps their functional importance diminishes with age, as I am inclined to believe of the corresponding structures in *Polystomum*. Especially those lying behind the large hooks seem to be important in the small

²⁷ Beiträge z. Entwickl. d. Eingeweidewürme, Pl. XIII., Fig. 3.

worms, as I find in two specimens the substance of the lamina projecting beyond the level of the rest with the base of the hook lodged in it.

Of the marginal hooks, most seem to have a trifurcate base, as represented in Fig. 14 (b); in others (a and c), there would seem to be a chitinous ring at the point of attachment similar to those noticed in the large hooks of *Dactylogyrus* by Wagener and V. Linstow.²⁸ The hooks situated in the centre of the suckers (a) appear to be slightly different from the others, additional chitinous rings of smaller size being present. The hooks measure about 0.025 mm. in length.

The mouth is situated in the middle of a somewhat funnel-shaped sucker upon the ventral surface of the head. From Dr. Osler's sketch I make out that the pharynx is situated shortly behind the mouth, and that the intestinal coeca diverge immediately from this to arch into each other (as in some forms of *Monostomum*) in the posterior fourth of the body.

The following is extracted from Dr. Osler's notes:

"The water-vascular system is well developed, beginning as a ramification of vessels about the anterior disc, and uniting to form two vessels, which run the whole length of the body, joining below, and opening somewhere between the posterior discs. Cilia are to be distinctly seen in the water-vascular system, especially at the junction of the tubes below. At the upper third of the body, on a level with the generative orifice, are seen on each side curious pulsating organs, which are undoubtedly connected with the water-vascular system, the pulsation occurring about once every minute and a half."

From the sketch accompanying this, these contractile bladders would seem to resemble in form, position and relative size, those represented in *Epibdella Hippoglossi*, by Van Beneden.²⁹

The lobes of the vitellogen occupy the sides of the body, but do not extend into the caudal lamina, nor further forward than the generative aperture.

This is situated immediately behind the bifurcation of the intestine. I have only been able to determine its position from the cirrus-coronet in the mounted specimens. Dr. Osler, however, saw the female aperture quite close to this, leading into a "narrow, slightly-curved vagina." This I have represented in Fig. 13; it is probably the unexpanded uterus.

²⁸ V. Linstow, *Trosch. Archiv.*, 1878. These seem also to be indicated in Zeller's figure, loc. cit., *Taf. XVII.*, Fig. 3.

²⁹ *Mémoire sur les Vers Intestinaux*, Pl. II., Fig. 2.

The structure of the cirrus-coronet is difficult to ascertain on account of the semi-opacity of my mounted specimens. The pieces do not seem to be more than eight in number; they converge anteriorly where they are narrow and pointed; posteriorly they are wider, with somewhat arrow-head shaped ends, which fit into the terminal bulbous portion of the vas deferens. I have been unable to follow the rest of this tube, or to find any trace of the testes.

Sphyrnura resembles *P. oblongum* and the precocious gill-cavity stage of *P. integerrimum*, in possessing only one complete shell-invested egg in the uterus at one time. This is very large (*v. supra*) in relation to the size of the worm, being considerably larger than the eggs of either *P. integerrimum* or *P. oblongum*. It consequently forms a noticeable feature in the worms possessing it, and is readily detectable with the naked eye. Numerous other eggs may be seen in the oviduct formed of the ovarian ova with the investing food-yolk-balls, and by mutual compression assuming various forms. What I suppose to be the ovary is represented in the figure to the right hand of the base of the muscular tube. I cannot find any trace of shell-gland, transverse vitello-duct, or of a vagina. All of these would undoubtedly be easily seen in fresh or well preserved specimens.

I regard the genera *Gyrodactylus*, *Dactylogyrus*, *Sphyrnura* and *Polystomum*, as forming a very natural assemblage. All probably live on the blood of their hosts, being found in positions where there is a more or less close superficial vascular plexus; all possess a caudal disc armed with fourteen to sixteen small and two (rarely more) large hooks, which enable the fish-parasites to secure themselves firmly to the gill-filaments of their hosts. Those which possess suckers formed around the smaller hooks are found attached to smoother surfaces (mucous membrane of mouth and urinary bladder), where the small hooks alone would have little purchase; even these forms, however, pass through a suckerless stage in which they inhabit the anterior respiratory part of the intestinal tract.³⁰ The resemblance of the *Polystomum*-larva to *Gyrodactylus* is very striking, so that if any phylogenetic speculations may be made from the observation of the ontogeny of an animal, the assumption is surely justi-

³⁰ It must be remembered that the mucous membrane covering the hyoid arches of many *Chelonia* has still a high respiratory significance. *Vide* Agassiz: *Contrib. Nat. Hist.*, U. S., Vol. I., Pt. II., pp. 271-284.

find that *Polystomum* is descended from a *Gyrodactylus*-like ancestral form. The suckers of *Polystomum* are not developed simultaneously, and *Aphyranura* is a transition form, where the formation of these is restricted to one pair.

The consideration of the probable relationships of the hosts of these forms lends additional authority to such a conclusion. If the piscine ancestors of Amphibia had *Gyrodactylus*-like gill-parasites, these would probably be transmitted to their descendants, and we should not be surprised that among the oldest representatives of these, two (the Frog-larva and *Necturus*) should possess such. The texture of the gills in *Necturus* might account for the change in the caudal armature. The loss of the gills in the Frog is necessarily accompanied by a change of habitaculum on the part of the parasite; and it is not surprising that the emigrating worms should have prospered so well in a locality where so many favourable conditions obtain as in the urinary bladder of the same host. That some *Chelonias* are the only reptiles in which parasites belonging to the same series have been found is probably to be accounted for by their aquatic habits.

Dactylogyrus may be regarded as a divergent form marked by its peculiar genital armature, the shape of the eggs, and the arrangement of the caudal hooks. In all of these points the three other genera approach each other more closely, and as *Gyrodactylus* is evidently nearer the stem-form than the others, all might be received into Van Beneden's family "*Gyrodactylida*."¹

CESTODES.

TAENIA DISPAR. Goetz.

I have to record another habitaculum for this worm. The specimen of *Rana halerina* above referred to (p. 6), expelled several ripe proglottides which seem to be much smaller than usual, as will be seen from the measurements given below. In the intestine of the frog were found several chains about an inch and a half in length, and also many scolices and immature chains of different lengths. Many more worms in the two latter conditions were also found in the body cavity between the viscera; whether these become mature in this position I am unable to say—they certainly frequently occur here.

¹ *Recherches sur les Trematodes marins*, Van Ben. and Hesse, p. 121.

The head does not measure more than 0.5 mm. across in any of my preserved specimens, nor in fact does any part of the chain. In life it is very variable in form, and bears a distinct unarmed rostellum which is frequently completely retracted, so as to escape notice, but acts much like a fifth sucker. This is merely indicated in Van Beneden's figure,³² and its existence is negatived in Diesing's and Dujardin's descriptions.

The only ripe proglottides observed were mostly of the form represented in Fig. 15, and measured 0.4×0.16 mm. Instead of containing a series of capsules in pairs with their contained embryos, two or three capsules at most were observed, with six or seven embryos altogether. These measured 0.027×0.018 mm.

NEMATODES.

ASCARIS ADUNCA. Rud.

A statement occurred in the "American Naturalist" in the course of last year, as to the prevalence of an *Ascaris* in the intestine of the American Shad—*Alosa sapidissima*, Storer. This was probably *A. adunca*, R. I have several specimens taken in last winter from Portland fish, which undoubtedly belong to this species.

The only other reference to a round worm from the American Shad of which I am aware is by Dr. Leidy, who records³³ *Agamonema capsularia* (?), Diesing, as free in the intestines. This, in spite of the "undivided lip," is probably the young of *A. adunca*, the "obtusely conical, minutely mucronate tail," arguing for this. Molin³⁴ describes "*Nematoideum Alausæ*" also with mucronate tail, but with a four-papillate mouth from the European Shad, but considers that the absence of lips forbids its reference to *A. adunca*. The metamorphoses of the mouth-parts in *Ascaris* are still insufficiently known, but what has been already established³⁵ does not exclude the possibility of both of the above larval forms belonging to *A. adunca*.

FILARIA TRIAENUCHA, n. sp.

A single female specimen of a worm belonging to the genus *Filaria* was found in the upper part of the proventriculus of each of the

³² Mém. sur les Vers Intest., Pl. XXII., Fig. 4.

³³ Proc. Ac. Sci. Phil., VIII., p. 55.

³⁴ Sitz. d. k. Akad. Wien., XXXVIII., p. 81.

³⁵ Schneider Monog. der Nemat., p. 294.

Bitterns above referred to, along with a single male of *Ascaris microcephala*, Rud. (?) in one of these; and although closely related to two species (*F. laticeps*, R., and *F. tridentata*, V. Linstow⁸⁶) which have been described from *Falco lagopus* on the one hand, and from *Colymbus arcticus* and *Larus ridibundus* on the other, it does not appear to resemble any of the numerous *Filariae* described from *Ciconiæ*, except perhaps *F. alata*.

I hope I may shortly have an opportunity of examining the disposition of the præ- and post- anal papillæ in the male, a character of essential systematic value in this genus; in the meantime, however, I record the following points which seem to distinguish it from the above mentioned forms:

Densely striated. Length 10 mm.; greatest breadth, 0.43 mm. A cervical fascia or frill, the tops of the lateral loops of which are 0.18 mm. from the anterior end, and which extends 0.405 mm. backwards on the neck. The root of the cervical papilla (or trifurcate spine) is 0.06 mm. from the end of the frill. The trident measures from the root to the end of the median fork 0.06 mm. The eggs measure 0.027 mm. $\times$ 0.018 mm. The tail is terminated by a short rounded conical projection.

A comparison of Fig. 16 with the figures of Schneider⁸⁷ and V. Linstow, will show how it differs from the similar structures represented there, the teeth of the trident being much longer and narrower in proportion to the body. The uterus was packed full of eggs, so that its walls were extended in every direction, occupying almost the whole of the body cavity.

ANCYRACANTHUS CYSTIDICOLA (Schn.) R.

I find this worm very commonly present in considerable numbers in the swim-bladder of *Salmo siscowet*, Ag. The males are, however, usually about twice (19–22 mm.) the length recorded by Schneider, while the females measure 30–33 mm. The two teeth (Fig. 17) which are doubtfully ascribed to the head by Schneider are quite evident in my specimens, and are continuous with two longitudinal ridges in the œsophagus. It is somewhat difficult, on account of the coiled up tail, to get a satisfactory view of the papillæ in the male, but there seemed to be five pairs of these behind the anus. The eggs measure 0.04 $\times$ 0.02 mm.

⁸⁶ Trosch. Archiv., 1877, pp. 10 and 175.

⁸⁷ Loc. cit., Taf. VI., Fig. 3.

ANCYTRACANTHUS SERRATUS, n. sp.

A single female specimen of a worm closely allied to the above was obtained from the auricle of the heart of *Coregonus albus*, Le S. It only measures 11 mm., and differs from *A. cystidicola* in the mouth-armature. Instead of having only the two teeth of that species, there are a series of smaller ones disposed, as represented in Fig. 18, round the anterior end. The eggs in this specimen were not mature, but the genital organs were observed to be arranged as in the above species. The structure of the œsophagus is sufficient to place the worm in this genus, and I propose provisionally for it the specific name "*serratus*."

Toronto, December, 1878.



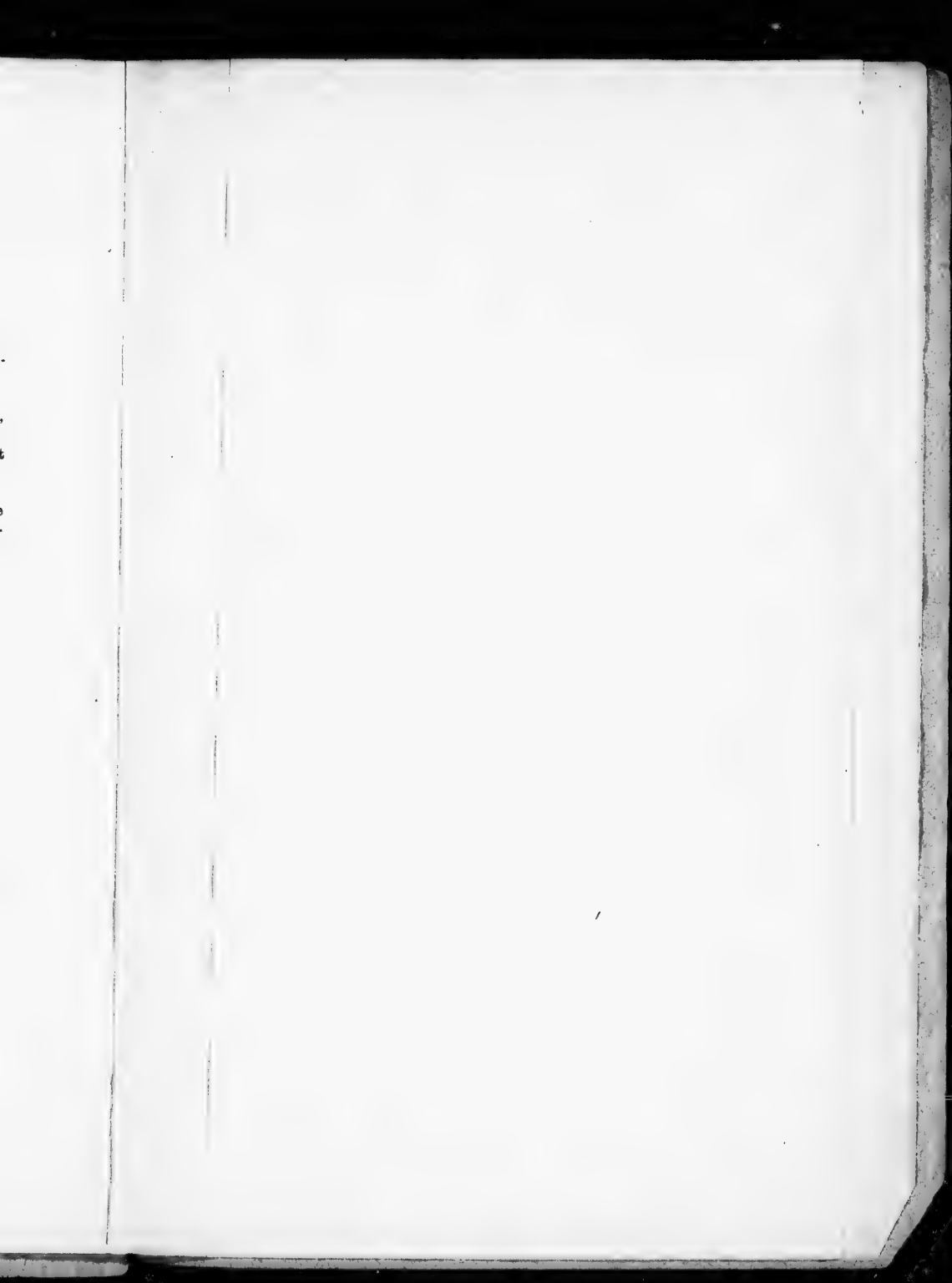
EXPLANATION OF THE FIGURES.

PLATE I.

- FIG. 1.—Distomum heterostomum, Rud. (?); *vi*, vitellogen; *sch*, "schluck-
öffnung;" *t*, testes.
- FIG. 2.—End of an intestinal coecum of the same.
- FIG. 3.—*D. asperum*, *n. sp.*; *ga*, genital aperture; *vo*, the ovary; *tv*,
transverse vitello-duct.
- FIG. 4.—Head of same; the characteristic disposition of the hooks is best
represented on the right side.
- FIG. 5.—An isolated body-spine of the same.
- FIG. 6.—*D. reticulatum*, *n. sp.*; the ventral sucker (*vs*) is flattened; *u*, the
uterus; *lv*, the ventral; *lvd*, the dorsal longitudinal vitello-
duct; *tt*, the testicular tubes.
- FIG. 7.—Surface view of intestinal epithelium of *D. variegatum*, Rud.
- FIG. 8.—Caudal sucker of *Octobothrium sagittatum*, F. S. Leuck. (?).
- FIG. 9.—*Polystomum oblongum*, *n. sp.*; *l*, larva; *ck*, cirrus-coronet; *va*,
vaginae; *ov*, shell-gland (?).
- FIG. 10.—Large caudal hook of the same.
- FIG. 11.—Small caudal hook of the same.
- FIG. 12.—*Sphyranura Osleri*, *n. sp.*; *ov*, eggs.
- FIG. 13.—Large caudal hook of same.
- FIG. 14.—Small caudal hook of same.
- FIG. 15.—*Proglottis* of *Taenia dispar*, Goeze.
- FIG. 16.—Cervical papilla of *Filaria triaenucha*, *n. sp.*
- FIG. 17.—Head of *Ancyracantius cystidicola*, Schn.
- FIG. 18.—Head of *A. serratus*, *n. sp.*

PLATE II.

- FIG. 19.—*Octobothrium sagittatum*, F. S. Leuck. (?); *ga*, genital aperture;
o, a mature ovum; *ov*, the ovary; *vd*, vas deferens.
- FIG. 20.—Anterior end of same to show shape of mouth, anterior suckers
and pharynx.
- FIG. 21.—Genital sucker of same; *a*, superficial; *b*, deeper view.
- FIG. 22.—Mature ovum.



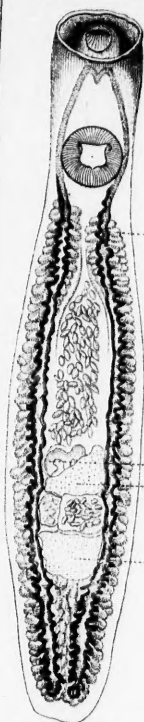


Fig. 1. $\times 16$.

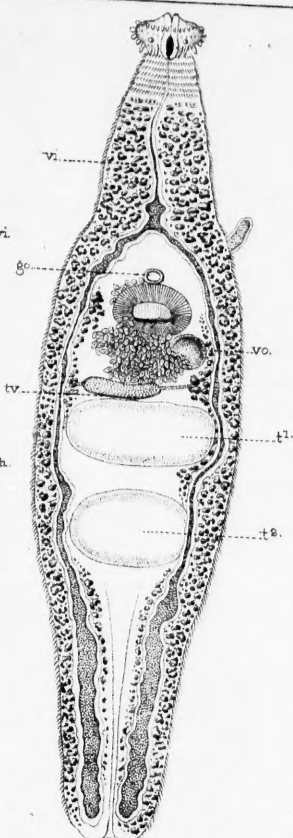


Fig. 3. 15.

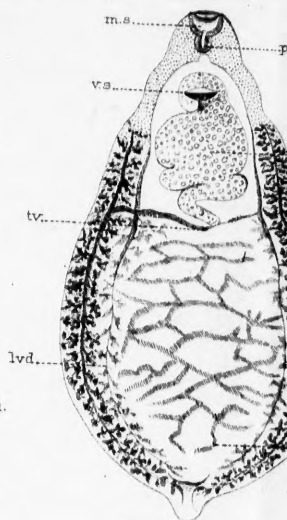


Fig. 6. $\times 5$.

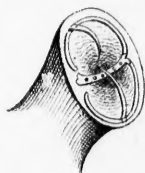


Fig. 8.



Fig. 2. $\times 40$

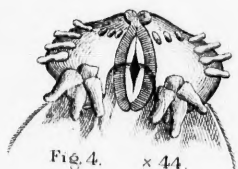


Fig. 4. $\times 44$.



Fig. 14. $\times 367$



Fig. 5. $\times 138$.



Fig. 7. $\times 266$.



Fig. 16. $\times 233$.

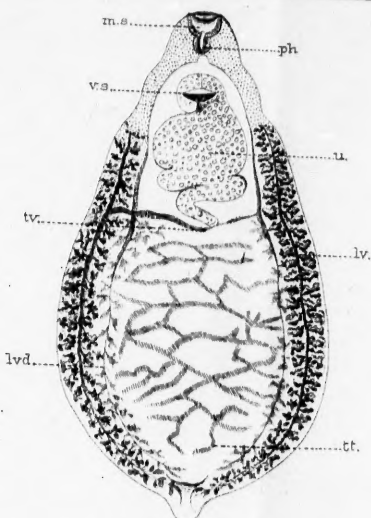


Fig. 6. x 5.

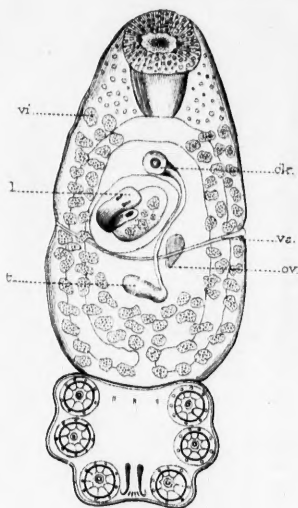


Fig. 9. 16.



Fig. 10. x 166.



Fig. 11.



Fig. 13. x 138.



Fig. 8.



Fig. 17.



Fig. 18.



Fig. 14. x 367.



Fig. 15. x 111.

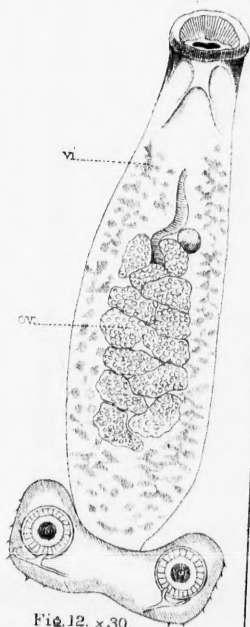


Fig. 12. x 30.



Fig. 16. x 233.

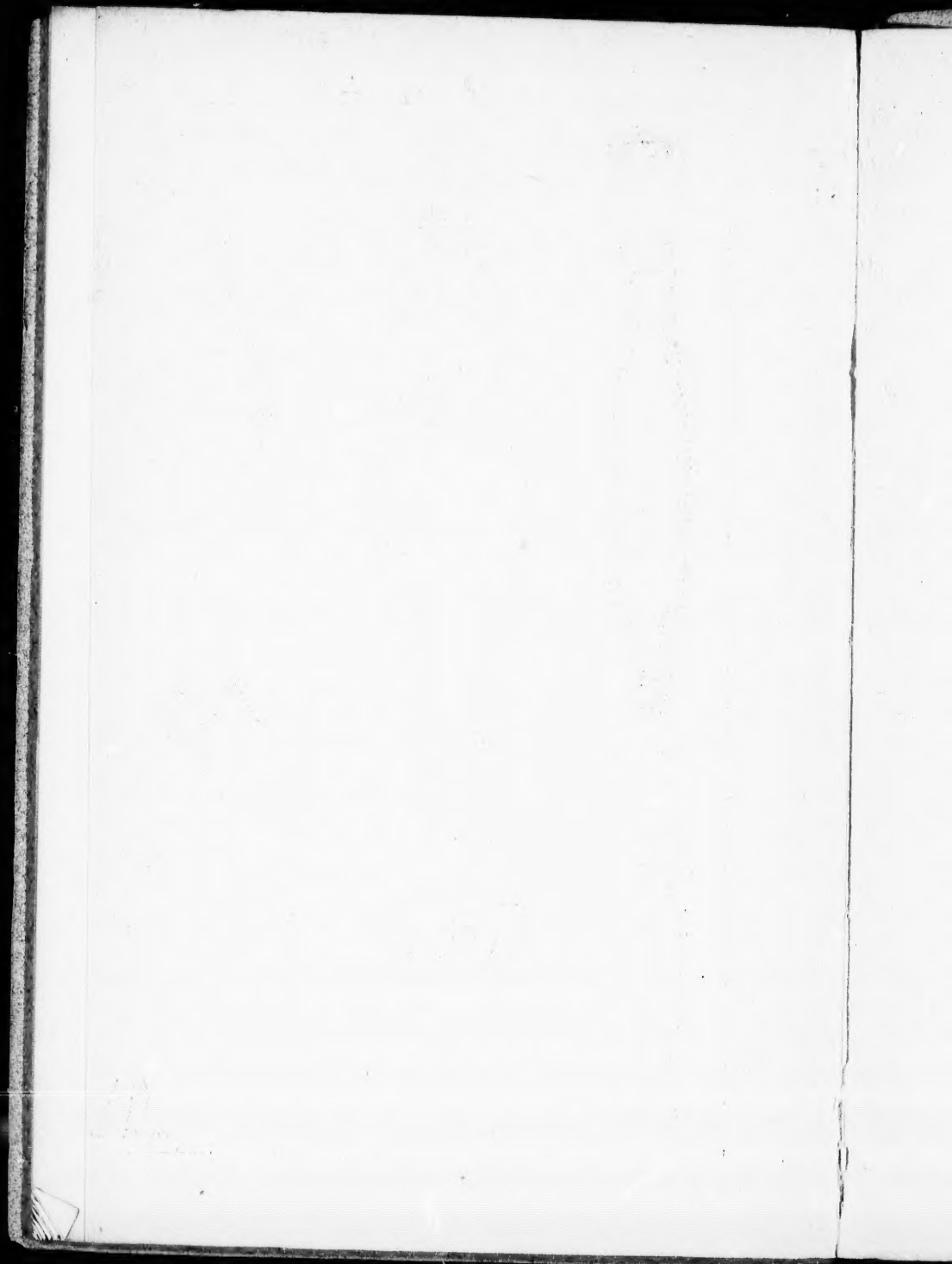




Fig. 22.

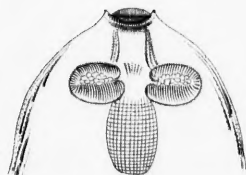


Fig. 20.

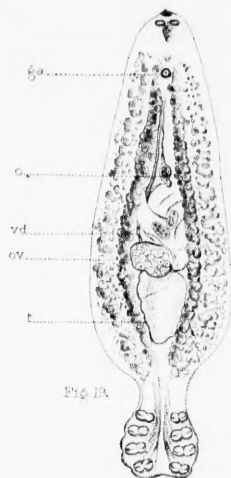
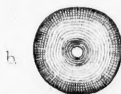


Fig. 19.



a

Fig. 21.



b